

## ABSTRACT OF THE INVENTION

This invention provides hydrogen-permeable membranes for separation of hydrogen from hydrogen-containing gases. The membranes are multi-layer having a central hydrogen-permeable layer with one or more catalyst layers, barrier layers, and/or protective layers. The invention also relates to membrane reactors employing the hydrogen-permeable membranes of the invention and to methods for separation hydrogen from a hydrogen-containing gas using the membranes and reactors. The reactors of this invention can be combined with additional reactor systems for direct use of the separated hydrogen.